3 Deep-water sharks; leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14)

3.1 Stock distribution

A number of species of deep-water sharks have been exploited in the ICES area. This section deals with leafscale gulper shark *Centrophorus squamosus* and Portuguese dogfish *Centroscymnus coelolepis*, which have been the two species of greatest importance to commercial fisheries.

In the past in some of European fisheries, landings data for the two species were combined for most of the period since the beginning of the fishery, under a generic term "siki".

3.1.1 Leafscale gulper shark

The leafscale gulper shark has a wide distribution in the Northeast (NE) Atlantic, from Iceland and Atlantic slopes south to Senegal, Madeira and the Canary Islands. On the Mid-Atlantic Ridge, it is distributed from Iceland to the Azores (Hareide and Garnes, 2001). The species can be demersal on the continental slopes (at depths of 230–2400 m) or have a more pelagic behaviour, occurring in the upper 1250 m of oceanic areas with seafloor around 4000 m (Compagno and Niem, 1998).

Available information suggests that this species is highly migratory (Clarke *et al*., 2001; 2002; Moura *et al*., 2014; Rodríguez-Cabello *et al*., 2016). In the NE Atlantic, the distribution pattern formerly assumed considered the existence of a large-scale migration, where females would give birth off the Madeira Archipelago, as there were reports of pregnant females (Severino *et al*., 2009) in that region. Geo-referenced data show that pregnant females also occur off Iceland, indicating another potentially important reproductive area in the northern part of the NE Atlantic (Moura *et al*., 2014). Juveniles are only caught rarely. Segregation by sex, size and maturity seems to occur, likely linked to factors such as depth and temperature. Post-natal and mature females tend to occur in relatively shallower sites. Pregnant females are distributed in warmer waters compared to the remaining maturity stages, particularly immature females, which are usually found at greater depths and lower temperatures (Moura *et al*., 2014). Although based on a small sample size, tagging studies have observed movements from the Cantabrian Sea to the Porcupine Bank (Rodríguez-Cabello and Sánchez, 2014; Rodríguez-Cabello *et al*., 2016) and north to the Faroes Islands (Rodríguez-Cabello, personal comm.).

Results from a molecular study, using six nuclear loci, did not reject the null hypothesis of genetic homogeneity among NE Atlantic samples (Verissimo *et al*., 2012). The same study showed that females are less dispersive than males and possibly philopatric. In the absence of clearer information on stock identity, a single assessment unit of the Northeast Atlantic has been adopted.

3.1.2 Portuguese dogfish

The Portuguese dogfish is distributed widely in the NE Atlantic. Stock structure and spatial dynamics are poorly understood. Specimens below 70 cm have been recorded rarely. The absence of small fishes in the NE Atlantic may be a consequence of their concentration in nurseries outside the sampling areas, movement to pelagic or deeper waters, gear selectivity or to different habitat and/or prey choices, with juveniles being more benthic (Moura *et al*., 2014). Consistent

results among different studies show that females move to shallower waters for parturition (Girard and Du Buit, 1999; Clarke *et al*., 2001; Moura and Figueiredo, 2012 WD; Moura *et al*., 2014). Similar size ranges and different maturity stages exist in both the northern and southern European continental slopes. The occurrence of all adult reproductive stages within the same geographical area and, in many cases in similar proportions among different areas, suggests that this species is able to complete its life cycle within these areas (Moura *et al*., 2014).

Population structure studies developed so far using microsatellites and mitochondrial DNA show no evidence of genetic population structure among collections in the NE Atlantic (Moura *et al*., 2008 WD; Verissimo *et al*., 2011; Catarino *et al*., 2015). In the absence of clearer information on stock identity, a single assessment unit of the Northeast Atlantic has been adopted.

3.2 The fishery

3.2.1 History of the fishery

Fisheries taking leafscale gulper shark or Portuguese dogfish are described in their respective stock annexes.

Since 2010, EU TACs for deep-water sharks have been set at zero. Consequently, reported landings for each of the two species since then were very low or zero.

In 2016, the EU fixed, for 2017 and 2018, a restrictive by-catch allowance, permitting limited landings of unavoidable by-catches of deep-sea sharks in directed artisanal deep-sea longline fisheries for black scabbardfish (Council regulation (EU) 2016/2285). Specifically, 10 tonnes were allowed for deep-sea sharks in Union and international waters of ICES subareas 5, 6, 7, 8 and 9, in Union and international waters of ICES Subarea 10 and in Union waters of CECAF 34.1.1, 34.1.2 and 34. 2. For 2019 and 2020, the allowed by-catch was established as 7 tonnes for each of these areas (Council regulation (EU) 2018/2025). Landings of deep-water sharks were prohibited in 2021, with no by-catch allowance. Discards are known to occur but were not quantified.

3.2.2 Species distribution and spatial overlap with fisheries

During 2011–2012, the project "Reduction of deep-sea sharks bycatches in the Portuguese longline black scabbard fishery" (Ref. MARE C3/IG/re ARES (2011) 1021013) was carried out to study the bycatch of deep-water sharks, mainly leafscale gulper shark and Portuguese dogfish, in the Portuguese longline fisheries targeting black scabbardfish (mainland Portugal, Azores and Madeira). The main objectives of this Project were to evaluate: i) the species distributions; ii) the spatial overlap between deep-sea sharks and black scabbardfish; and iii) the efficiency on deep-water shark by-catch under modifications of the fishing gear.

WGEF considers that this study does not provide sufficiently detailed information on the distribution of deep-water shark species and on their stocks' status, as it was restricted to the reduced fishing areas exploited by deep-water longline fisheries targeting black scabbardfish. The data and the low sampling levels were considered insufficient to provide the spatial coverage to allow the evaluation of the spatial overlap between deep-sea sharks and black scabbardfish. Biomass indices were derived from a combination of quite distinct data sources, including logbooks and on-board observations. Each of these two data sources have substantial caveats and their combination have been done without taking these into consideration. As a consequence, the results should be scrutinized with caution; for instance, the trends presented in the report were not clearly supported by data and information available. No technical modifications introduced to minimize the deep-sea sharks bycatch levels on the fishing gear were evaluated.

Geostatistical studies (Veiga *et al*., 2013; Veiga *et al*., 2015 WD) using deep-water longline black scabbardfish fishery data (vessel monitoring systems, logbooks and official daily landings) were conducted with the aim of evaluating the spatial distribution and spatial overlap between i) black scabbardfish and leafscale gulper shark and between ii) black scabbardfish and Portuguese dogfish taken by the longline fishery operating off mainland Portugal (Division 9.a). Results obtained indicated that in fishing grounds where black scabbardfish is more abundant and where fishing takes place, the relative occurrence of both deep-water shark species was reduced. These differences on the relative occurrence have implications for alternative management measures to be adopted in the deep-water longline black scabbardfish fishery, particularly in what concerns the minimization of deep-water shark bycatch. The existence of differences in the deep-water sharks' abundance between fishing grounds for black scabbardfish and deeper fishing grounds was further supported by results from a short-duration pilot survey on board commercial fishing vessels belonging the Portuguese mainland black scabbard fishery in 2014 (Veiga, 2015 WD). Under this survey, ten fishing hauls were performed by 5 vessels, each vessel performing one haul at the fishing grounds exploited by the black scabbardfish fleet (BSF fishing grounds) and other located at deeper areas adjacent to these fishing grounds. For all vessels, the proportions of each shark species (~ quotient between the caught weight of the deep-water shark under analysis and the sum of the caught weight of black scabbardfish and of that deep-water shark) was significantly smaller in hauls performed at the BSF fishing grounds and those located deeper (Table 3.4).

In addition to the conclusions drawn by these studies, a recent analysis of onboard data collected at commercial vessels belonging to the Portuguese deep-water longline fishery that takes place in ICES Subarea 9 suggests that *C. squamosus* and *D. calceus* have a higher spatial overlap with the fishery for black scabbardfish than *C. coelolepis* (Figueiredo and Moura, 2019 WD). Worth to mention that *C. squamosus* and *D. calceus* have a widespread distribution and undertake migrations associated to reproduction (despite those from the *D. calceus* being less understood).

As a reaction of the restrictive EU management measures adopted for deep-water sharks, fishing vessels also tend to avoid fishing grounds where deep-water sharks are more likely to be caught. No survival of sharks when returned to the sea is expected. The only evidence of survival of deep-water sharks after longline catch was reported for leafscale gulper sharks following a Spanish scientific tagging survey. The survey used deep-water longlines, which were laid at depths ranging from 900 to 1100 m (Rodríguez-Cabello and Sánchez, 2014; 2017). In that study, the soaking time was restricted to 2–3 hours and the lines were hauled back at a speed of 0.4–0.5 m s^{-1}. It is important to note that these fishing practices are different from those used by commercial vessels.

3.2.3 The fishery in 2020

No new information.

3.2.4 ICES advice applicable

Leafscale gulper shark: in 2019, ICES advised that "*when the precautionary approach is applied there should be zero catches in each of the years 2020–2023.*".

Portuguese dogfish: in 2019, ICES advised that "*when the precautionary approach is applied there should be zero catches in each of the years 2020–2023.*".

3.2.5 Management applicable

The EU TACs that have been adopted for deep-sea sharks in European Community waters and international waters for different ICES subareas are summarized below.

Year	ICES subareas		
	5–9	10	12 (includes also *Deania histricosa*[5] and *Deania profondorum*)
2005 and 2006	6763	14	243
2007	2472[1]	20	99
2008	1646[1]	20	49
2009	824[1]	10[1]	25[1]
2010	0[2]	0[2]	0[2]
2011	0[3]	0[3]	0[3]
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	10[4]	10[4]	0
2018	10[4]	10[4]	0
2019	7[4]	7[4]	0
2020	7[4]	7[4]	0
2021	---	---	---

(1) Bycatch only. No directed fisheries for deep-sea sharks are permitted.

(2) Bycatch of up to 10% of 2009 quotas is permitted.

(3) Bycatch of up to 3% of 2009 quotas is permitted.

(4) Exclusively for bycatch in longline fishery targeting black scabbardfish. No directed fishery shall be permitted.

(4) Recent studies demonstrated that there is not enough scientific support to discriminate *Deania hystricosa* from its congener *Deania calceus*; they are likely the same species (Rodríguez-Cabello *et al*., 2020; Stefanni *et al*., 2021)

Since 2013, the deep-sea shark category includes the following species (Council regulation (EC) No 1182/2013): Deep-water catsharks *Apristurus spp*., frilled shark *Chlamydoselachus anguineus*, gulper sharks *Centrophorus spp*., Portuguese dogfish *Centroscymnus coelolepis*, longnose velvet dogfish *Centroscymnus crepidater*, black dogfish *Centroscyllium fabricii*; birdbeak dogfish *Deania calceus*; kitefin shark *Dalatias licha*; greater lantern shark *Etmopterus princeps*; velvet belly *Etmopterus spinax*; mouse catshark *Galeus murinus*; six-gilled shark *Hexanchus griseus*; sailfin roughshark *Oxynotus paradoxus*; knifetooth dogfish *Scymnodon ringens* and Greenland shark *Somniosus microcephalus*.

Since 2015, the leafscale gulper shark and the Portuguese dogfish, have been included on the EU prohibited species list for Union waters of Division 2.a and Subarea 4 and in all waters of Subareas 1 and 14 (Council Regulation (EC) No 2015/104, Art. 12:1(g)).

Since 2013, under NEAFC Recommendation, 7 it was required that Contracting Parties prohibit vessels flying their flag in the Regulatory Area from directed fishing for deep-sea sharks on the following list: *Centrophorus granulosus, Centrophorus squamosus, Centroscyllium fabricii, Centroscymnus coelolepis, Centroscymnus crepidater, Dalatias licha, Etmopterus princeps, Apristurus spp, Chlamydoselachus anguineus, Deania calceus, Galeus melastomus, Galeus murinus, Hexanchus griseus, Etmopterus spinax, Oxynotus paradoxus, Scymnodon ringens* and *Somniosus microcephalus*.

In 2005, the use of trawls and gillnets in waters deeper than 200 m in the Azores, Madeira and Canary Island areas was banned (Council Regulation (EC) No 1568/2005). In 2007, the use of gillnets by Community vessels at depths greater than 600 m in ICES divisions 6.a-b, 7.b-c, 7.j-k and Subarea 12 was banned while a maximum bycatch of deep-water shark of 5% in hake and monkfish gillnet catches was allowed (Council Regulation (EC) No 41/2007). Since 2009, the "rasco (gillnet)" fishing gear was banned at waters deeper than the 600 m isobath (EC Regulation 43/2009). A gillnet ban in waters deeper than 200 m is also in operation in the NEAFC regulatory Area (all international waters of the ICES Area). NEAFC also ordered the removal of all such nets from NEAFC waters by 1 February 2006.

Since 2016, and in order to mitigate the potential damaging impacts of bottom trawling, fishing with bottom trawls was ban at depths deeper than 800 metres (EU Regulation 2016/2336).

A bycatch TAC for deep-water sharks was allowed for each of the years from 2017 to 2020, on a trial basis, in the directed artisanal deep-sea longline fisheries for black scabbardfish (Council regulation (EU) 2016/2285; Council regulation (EU) 2018/2025). According to this limited landing of unavoidable by-catches of deep-sea sharks were allowed and Member States should develop regional management measures for the black scabbardfish fishery and establish specific data-collection measures for deep-sea sharks to ensure their close monitoring. Specifically, 10 and 7 tonnes were allowed for deep-sea sharks in Union and international waters of ICES subareas 5, 6, 7, 8 and 9, in Union and international waters of ICES Subarea 10 and in Union waters of CECAF 34.1.1, 34.1.2 and 34. 2 in 2017–2018 and 2019–2020, respectively. This allowance was in accordance with ICES indications according to which in the artisanal deep-sea longline fisheries for black scabbardfish, the restrictive catch limits lead to misreporting of unavoidable by-catches of deep-sea sharks, which are currently discarded dead.

The Council regulation (EU) 2016/2285 affects specifically the Portuguese deep-water longline fishery targeting black scabbardfish in ICES Division 9.a and Subarea 10. As a response, Portugal has proposed an action plan focusing the black scabbardfish fishery and this plan is coordinated by the Portuguese General Directorate of Fisheries. Among other objectives, under this plan different management strategies were expected to be evaluated.

The council regulation (EU) 2021/91 fixing, for the years 2021 and 2022, the fishing opportunities for Union fishing vessels for certain deep-sea fish stocks, prohibits to fish for deep-sea sharks in ICES subareas 5 to 9, in Union and international waters of ICES subarea 10, in international

waters of ICES subarea 12 and in Union waters of CECAF areas 34.1.1, 34.1.2 and 34.2, and to retain on board, tranship, relocate or land deep-sea sharks caught in those areas, with no exceptions.

3.3 Catch data

3.3.1 Landings

Landings of leafscale gulper shark and Portuguese dogfish have historically been included by many countries in mixed landings categories (e.g. sharks 'nei' and dogfish 'nei').

During WKSHARK2, landing data provided by country was revised in relation to data quality (including taxonomic categories). Protocols to better document the decisions to be made when estimating WG landings were also developed (ICES, 2016).

For the years before 2005, it was not possible to determine identity to species level and hence the landings presented here are of "siki" sharks. "Siki" landings are a mixed category comprising mainly *C. squamosus* and *C. coelolepis* but also including unknown quantities of other species (Table 3.1). Past efforts made by WGEF to assign mixed landings by species are described in the Stock Annex. Landings estimates from 2005 onwards were revised following WKSHARK2, and are presented by species (Tables 3.2 and 3.3).

Figure 3.1 shows the Working Group estimates of combined landings of the two species by country and Figure 3.2 shows Working Group estimates of combined landings of the two species by ICES area.

Landings have declined from around 10 000 t in 2001–2004 to one tonne in 2012. The recent decrease in landings is mostly related to the imposition of the EU TAC, which has been set at zero catch since 2010. In 2020, Portugal landed 4.3 and 8.8 tonnes of leafscale gulper shark and Portuguese dogfish, respectively.

3.3.2 Discards

Since 2010, and excluding the limited by-catch allowance for the longline fisheries (see section 3.3.5) in 2017–2020, the EU TACs for deep-water sharks have been zero, and consequently it was admitted that the discarding in deep-water fisheries had increased. However, with the several EU regulations in place, particularly the ban of gillnet, entangle and trammel net fisheries at depths >600 m and trawl deep-water fisheries at depths >800 m, the potential bycatch and subsequent discarding of Portuguese dogfish and leafscale gulper shark is now thought to be relatively low. Since 2010, that discard information is limited to some years and countries.

Portugal. The IPMA on-board sampling programme of Portuguese commercial vessels that operate deep-water longlines to target black scabbardfish (métier LLD_DWS_0_0_0), started in mid-2005. Sampling effort was fixed at three trips per quarter and sampled trips and vessels were selected in a quasi-random sampling (Fernandes *et al*., 2011 WD). However, it is considered that spatial coverage by the sampling is insufficient to allow discards to be raised to the whole fleet (Prista *et al*., 2014 WD).

To evaluate the level of shark bycatch and discards, and to increase knowledge of the fishery, a pilot study on the Portuguese trammel net fishery targeting anglerfish in Division 9.a (200–600 m deep) took place, under the PNAB/DCF from 2012–2014 (Moura *et al*., 2015 WD). Results showed that the fishery targeting anglerfish at depths of 200–600 m had a low frequency of occurrence of Portuguese dogfish. No specimens of leafscale gulper shark were ever sampled. Despite these results, higher frequencies are likely to be observed at depths >600 m.

Spain. The Spanish Discards Sampling Programme for Otter and Pair Bottom Trawl (OTB and PTB) fleets, covering ICES subareas 6–7 and divisions 8.c and 9.a started in 1988; however, it did not have annual coverage until 2003. The sampling strategy and the estimation methodology used follows the "Workshop on Discard Sampling Methodology and Raising Procedures" guidelines (ICES, 2003) and more details of this applied to this area were explained in Santos *et al*. (2010 WD).

Estimated discards of leafscale gulper shark in 2019 were 0.4 tonnes.

Discards of *Centrophorus* spp. are presented in Table 3.5. The estimates are not species-specific; it is unknown whether observers have the necessary identification skills and experience to reliably identify the various species. It should also be noted that observer coverage in this fishery is low and thus a very large raising factor was applied. The species composition of discards suggests that the fishery operates at depths shallower than the usual depth range for *Centrophorus* spp. As a consequence, it is admitted that *Centrophorus* contribute for only a small percentage of the total discards. It does not appear that the sampling has been stratified to account for this depth effect and this probably explains the high inter-annual variation. The results presented in Table 3.4 can therefore not be considered reliable estimates of the quantities discarded. They are included in this report as indicative that some discarding of this genus does occur, and this may be of relatively large magnitude.

France. Estimated discards of Portuguese dogfish and leafscale gulper shark from the trawl fleet in 2018 were 172 tonnes.

In 2012 (10 vessels), 2013 (12 vessels) and 2014 (11 vessels) landed >10 tonnes of roundnose grenadier *Coryphanoides rupestris*, black scabbardfish *Aphanopus carbo* and blue ling *Molva dypterygia*. The catch of these 10–12 vessels represented 99% of the total French landings per year of these three species. In the three years, from 2012 to 2014, observers were onboard at 7, 10 and 8 of these vessels, respectively. The fishery for these three deep-water species is carried out to the west of Scotland, Ireland and in Faroese waters. The majority of the landings are from divisions 6.a, 5.b and 7.c, with an additional 2–3% coming from 7.j. In 2014, all on-board observations came from divisions 6.a and 7.b-c.

Other deep-water species landings made from French vessels are mostly bycatch in demersal fisheries.

The depth distribution of French on-board observation was assessed by selecting all hauls where a catch of roundnose grenadier, black scabbardfish or blue ling was recorded. Over this eleven-year period, the proportion of deep hauls sampled has reduced (Figure 3.3). In 2014, no hauls deeper than 1200 m were sampled, although the on-board observations covered more than 350 hauls. WGDEEP (ICES Working Group on the Biology and Assessment of Deep-sea Fisheries Resources) made the same observation based upon logbooks reported by deep-water fishing vessels, which cover a larger number of hauls (logbooks are not used here since they only include data on landed species and not on deep-water elasmobranchs).

French bycatch of Portuguese dogfish and leafscale gulper shark occurs mainly, if not only, in the deep-water fishery to the West of Scotland. The frequency of occurrence of the two deep-water shark species in French on-board observations does not show clear trends. Variations, including lower occurrence of Portuguese dogfish in recent years or the higher occurrence in 2009–2014 of leafscale gulper shark, may result from the shallower distribution of the fishing grounds (Table 3.6).

French discards were raised using the standard procedure developed in the COST project (Anon., 2009; Jansen *et al*., 2009). The raising of discards to the total fleet activity is problematic. In addition to difficulties identified for several species, Portuguese dogfish and leafscale gulper shark are not landed so that discards cannot be raised to the discards-to-landings ratio and

raising should be done using an effort measure. Raising can be done by fishing time, number of trips, number of fishing operations and number of fishing days. Raising to those fishing effort variables returned different discard estimates, which range from 13–200 tonnes of Portuguese dogfish and from 40–700 tonnes of leafscale gulper shark.

Ireland. Discard data from Ireland is available from 2009 to 2017 for the Portuguese dogfish from the trawl fleet operating in ICES divisions 27.6.a and 27.7.bgj. Discards are considered negligible as values estimated are <1 tonne in most of the years.

3.3.3 Quality of the catch data

Historically, very few countries have provided landings data disaggregated by species. Portugal has supplied species-specific data for many years. Since 2003 onwards, other countries have increased species-specific reporting of landings but some of these data may contain misidentifications.

Furthermore, it is believed that immediately prior to the introduction of quotas for deep-water species in 2001, some vessels may have reported deep-water sharks as other species (and vice versa) in an effort to build up track record for other deep-water species (or deep-water sharks). It was also likely that, before the introduction of quotas for deep-water sharks, some gillnetters may have reported monkfish as sharks.

Misreporting is likely to have increased as a reaction to the EU restrictive measures adopted for deep-water sharks. As an example, the data from the DCF landing sampling programme at Sesimbra landing port in 2009 and 2010 revealed the existence of misidentification problems (Lagarto *et al*., 2012 WD). In 2014, sampling data derived from 13 trips on deep-water longliners (a small proportion of the total number of trips) indicate that nearly 50% of the sampled specimens landed as *Galeorhinus galeus* corresponded to leafscale gulper shark and Portuguese dogfish. Misidentification issues persisted until 2016.

IUU fishing is thought to occur, especially in international waters.

3.3.4 Discard survival

No information is available for commercial fishing operations. Scientific studies have recently tagged leafscale gulper sharks caught by longline at depths of 900–1100 m, indicating that they are capable of surviving after capture and release (Rodríguez-Cabello and Sánchez, 2014; Rodríguez-Cabello and Sánchez, 2017). In this studies, at-vessel mortality (for *C. squamosus* and *C. coelolepis* (proportion of fish that are dead when the fish are brought on board) was low: 1.2%, and 4.5%, respectively. However, if including also specimens scored in poor condition, at vessel mortality increased to 18.9% and 38.6%, respectively.

It is important to remark that in these studies, the soaking times were restricted to 2–3 hours and the fishing gear was hauled in at a much slower speed (0.4–0.5 m s^{-1}) than under normal fishing practices.

3.4 Commercial catch composition

3.4.1 Species composition

No new information.

Between 2006 and 2011, WGEF, using catch ratios from various historical sources, made a number of attempts to split mixed landings data by species. The benchmarked procedure agreed by

WKDEEP 2010 is described in the Stock Annex. This methodology was further explored by a dedicated workshop on splitting of deep-water shark historical catch data in 2011 (ICES, 2011). Results from this meeting indicated that the ratio between leafscale gulper shark and Portuguese dogfish varied considerably both temporally and spatially data from 2005 onwards was revised in WKSHARK2.

3.4.2 Length composition

No new information is available.

3.4.3 Quality of catch and biological data

Despite past efforts to improve the quality of data, particularly on species composition, considerable uncertainties persist on historical data (ICES, 2011; ICES, 2016).

Since the reduction of EU TACs to zero, significant quantities of the two deep-water shark species under consideration are likely to be discarded by deep-water fisheries. Despite some sampling effort on discards has been undertaken, the sampling effort is clearly insufficient to estimate the quantities caught.

3.5 Commercial catch-effort data

No new data.

3.6 Fishery-independent surveys

Since 1996, Marine Scotland Science has been conducting a monitoring deep-water survey in Subarea 6 at depths ranging from 300–2040 m. This survey can be considered to be standardised in terms of depth coverage since 1998. More information on this survey is presented below.

In September, from 2006 to 2008, and in December 2009, Ireland carried out annual deep-water surveys in subareas 6 and 7. Fishing hauls were performed off north-western Ireland and west of Scotland, and the Porcupine Bank area to the west of Ireland at depth strata: 500 m, 1000 m, 1500 m and 1800 m. No further surveys have since taken place. The Irish deep-water survey and other surveys were part of a planned coordinated survey in the ICES area, through the Planning Group on Northeast Atlantic Continental Slope Surveys (WGNEACS).

A new Irish trawl survey (IAMS) began trawling deep-water stations in 2018, but data have not yet been analysed.

The WGNEACS 2012 was dedicated mainly to the design of a longline survey in Bay of Biscay and Iberian waters. One of its main objectives would be to clarify the distribution of all the deep-water sharks and to provide data to monitor their stock status, in the absence of commercial fisheries data.

From 2015 to 2020, AZTI conducted a deep-water longline survey (PALPROF) along the Basque Coast, Bay of Biscay (ICES Division 8.c), onboard a commercial longliner. More information on this survey is presented below.

3.7 Life-history information

No new information.

3.8 Exploratory assessments

3.8.1 Analyses of Scottish deep-water survey data

Survey indicators from the Scottish deep-water survey have been investigated since 2012 (Figures 3.4 and 3.5. There was no new work on this data in 2021, see reports from previous years for a full account.

3.8.2 Analyses of AZTI survey

New information from the PALPROF survey in the Bay of Biscay, updating the data presented previously (WD01 - Diez *et al.*, 2021). The PALPROF survey was conducted annually from 2015 to 2020 with the main objective of estimating and assessing the inter-annual variation of the abundance and biomass indices of the deep-water sharks and other ichthyofauna. The surveyed area is located in an area 10.5 km North of the Cape Matxitxako (ICES 27.8.c east) close to a narrow canyon of about 28 km length, where the bottom depth progressively increases from 500 to 2500 m. Based on canyon valley depth profile and for a depth range from 650 m to 2400 m, 400 m depth interval strata were considered. In each survey six fishing hauls were performed. To get homogeneous and comparable data series the six hauls were repeated every year in the same position and at the same time of the year.

To minimize the mortality of deep-water sharks, the number of hooks of a former commercial deep-water-sharks longline was reduced to 300. Five small sensors DST CTD and DST centi (www.star-oddi.com) were used to continuously monitor depth, temperature and salinity (every 30 s). The sensors were able to withstand 2400–3000 m in depth, respectively, and were placed on the main line of fishing gear (Figure 3.6).

Data on status of the hook were recorded during the hauling and the recovering of the long line. The categories considered were: i) **E** - Hook with bait; ii) **C** - Hook with bait partially eaten; iii) **R** - Broken-Tangled hook; iv) **V** - Empty hook (no catch, no bait); v) **P** - Hook with catch and vi) **N.O.** - Hook status not Observed/recorded during recovering of the line.

On board, all fish specimens caught were sorted and species identified to the lowest taxonomic level possible. Also, each specimen was measured (cm), sexed and the condition (dead or alive) recorded. Individual body weight was estimated based on species length/weight relationships. The effective fishing effort performed in each stratum (EFFORTst) corresponded to the number of hooks able to fish during the haul, i.e. P + E + C divided by the total of hooks and multiplied by the soaking time (minutes):

EFFORTst: ((P + E + C) / total hooks) x soak time (minutes)

For each *stratum* the CPUE of species **i** was calculated as the ratio of catch of i^{th} species (kg) and EFFORTst.

During the six years of the survey, 13 different species of sharks and 2 chimaeras were caught. Sharks and chimaeras were less frequently caught in the floating sections of the fishing gear than at the bottom sections (Figure 3.7). The highest CPUE values were recorded for *C. coelolepis*, especially in 2016, 2019 and 2020. The CPUE values for *C. squamosus* were variable, but close to 25 kg $hook^{-1}$ min^{-1} in 2018, decreasing since then (Figure 3.13). Abundance of *C. coelolepis* was highest in the 1451–1850 strata whereas *C. squamosus* presented similar percentage of abundance in the 1051–1450 m and in the 1451–1850 strata.

3.8.3 Analyses of on-board Portuguese data

IPMA analysed the onboard data collected under Data Collection Framework (PNAB/DCF) for the deep-water sharks *Centroscymnus coelolepis*, *Centrophorus squamosus* and *Deania calceus* (Figueiredo and Moura, 2019WD). The analysis covered a period from 2009 to 2018 during which data on deep-water sharks was collected by onboard observers of the deep-water longline fishery targeting the black scabbardfish (LLD-DWS *métier*) in Division 9.a.

The sampling effort assigned to LLD-DWS *métier* was settled following the Neyman criterion. According to this, the optimum number of trips to be performed per vessel at Sesimbra landing port was estimated as 3 trips per month (margin of error of 1 with 95% probability). Several factors have been constraining the reach of this target and the sampling effort obtained thought time has been much lower.

Figure 3.8 presents, for each year, the geographic locations of the sampled fishing hauls for the whole set of on-board fishing trips. Before 2014, sampled fishing hauls were mainly located northwards while after, the fishing hauls locations were more disperse, covering a more southern area. Important to note that these spatial differences do not reflect any change on fleet dynamics but are rather related to the opportunistic feature of the LLD-DWS *métier* sampling plan.

The initial objective of this analysis was to estimate the level of by-catch of the main deep-water sharks by year and by area in addition to evaluate any potential trend during this time period, to compare with catch levels prior to 2007 (when the TAC started to restrict landings). However, the sampling effort achieved is considered insufficient to provide reliable information on the abundance or biomass trend of deep-water shark species. The spatial locations of the fishing hauls are heterogeneously dispersed along time and the vessels sampled also changed. It should be noted that given the vessel site fidelity, there is a confounding effect between the fishing vessel and the fishing grounds and with the distribution patterns of each species, difficult to disentangle. The results obtained from the onboard analysis are presents below, by species.

Portuguese dogfish. The relative occurrence of *C. coelolepis* at the sampled fishing hauls, by year, varied between 33 and 100%. The number of specimens caught varied, not only among years, but also among vessels. The highest number of specimens caught by fishing haul were consistently recorded in some places (Figure 3.9). The geographic information of the catches of *C. coelolepis* supports previous studies where it was concluded that the black scabbardfish fishery operate at locations of lower abundance of *C. coelolepis* (Veiga *et al.*, 2015 WD). This species is thought to be able to complete its life cycle in the same geographical area (although sampling data on newborns is scarce) (Moura *et al.*, 2014) suggesting the existence of local populations.

Leafscale gulper shark. *Centrophorus squamosus* was quite frequently caught but its relative occurrence by fishing haul and by year varied between 17 and 100%. Also, the number of specimens caught per fishing haul varied not only among years but also among vessels. The data available were considered insufficient to estimate the level of by-catch and did not put in evidence any temporal trend. This fact might be associated with the spatial changes of the sampled fishing hauls along time (Figure 3.10).

3.9 Stock assessment

No new assessments were undertaken in 2021.

3.10 Quality of the assessments

The knowledge of deep-water shark species distribution and stock structure in the northeast Atlantic are highly deficient. Available abundance and biomass indices are restricted to a few areas and estimates are highly variable and uncertain. Furthermore, the data derived from discards sampling is not adequate to estimate the quantities caught or needs further investigation. Therefore, a major scientific investment is required to gain a full understanding of the spatial and temporal population dynamics of deep-water sharks to enable estimates of sustainable exploitation levels. Several strategies to be adopted to monitor species abundance and evaluate fishing impact on their populations by the different deep-water fisheries have been discussed in previous meetings and included the: i) increase of close monitoring of deep water shark populations; ii) development of specific studies to assess the distribution patterns of species and estimate the spatial overlap with fisheries; iii) evaluation of the effect on the by catch of deep water sharks of modifications in deep water fishing operations (Figueiredo and Moura, 2016 WD)

In the absence of fishery-dependent data, the status of these species can only be ascertained from fishery-independent data. Abundance indices used in previous assessments were exclusively derived from the Scottish deep-water survey. However, there are concerns of applying this survey to infer stock status as the Scottish survey takes place in a small proportion of the management area. Furthermore, these data are only available for the period after the development of the fishery. There are no fishery-independent data for areas further south, which prevents understanding of trends in abundance in these areas.

Many countries formerly reported landings of Portuguese dogfish and leafscale gulper shark combined with other deep-water sharks in categories such as “siki sharks”. Unless suitable data can be found to enable splitting of the catch data, historical catch levels by species will remain uncertain.

3.10.1 Historical assessments

The application of the benchmarked model requires historical data discriminated by species from the different areas within the stock NE Atlantic. Such data is unavailable, as historical data is not split by species. Efforts so far, e.g. WKSHARK (ICES, 2011) were not able to split the historical data. Current discard estimates are not standardized yet so it cannot be used for further catch estimates.

3.11 Reference points

There are not reference points for these stocks.

3.12 Conservation considerations

The Red List of European marine fish considered both leafscale gulper shark and Portuguese dogfish to be Endangered (Nieto *et al*., 2015).

Recent IUCN assessments for a group of deep-water sharks classified the Portuguese dogfish as globally Near Threatened with signs of increase in the population inhabiting the NE Atlantic (Finucci *et al*., 2020a). The Leafscale gulper shark was classified as globally Endangered, with signs of reduction of the population in the NE Atlantic (Finucci *et al*. 2020b).

3.13 Management considerations

Some species of deep-water shark are considered to have very low population productivity.

Based on the precautionary approach, ICES has routinely advised against targeted fisheries on leafscale gulper shark and Portuguese dogfish.

Whilst the zero TAC for deep-water sharks has prevented targeted fisheries for deep-water sharks, these species can still be a bycatch in some deep-water fisheries. The level of bycatch in these fisheries is uncertain but is now assumed to be relatively low given the EU regulations adopted for deep-water fisheries (see Section 3.3.5).

There are limited data to evaluate the stocks of these species. The Scottish deep-water survey provides a meaningful time-series of species-specific data, but this started after the fishery being established, and only covers part of the stock range for both the leafscale gulper shark and the Portuguese dogfish. The PALPROF survey in the Bay of Biscay provides new fishery-independent data since 2015, but also covers a small area. Fishery-independent data from other areas of the stock range are limited or lacking.

3.14 References

Anonymous. 2009. Common tool for raising and estimating properties of statistical estimates derived from the Data Collection Regulation. User manual, version 1.1, 135 pp.

Campbell, N. 2018. Analyses of Scottish deep-water survey data. Working Document presented in the ICES Working Group on Elasmobranch Fishes (WGEF), Lisbon, June 2018. 12pp.

Catarino, D., Knutsen, H., Veríssimo, A., Olsen, E. M., Jorde, P. E., Menezes, G., Sannaes, H., Stankovi, D., Company, J.B., Neat, F., Danovaro, R., Dell'Anno, A. Rochowski, B., Stefanni, S. (2015). The Pillars of Hercules as a bathymetric barrier to gene flow promoting isolation in a global deep-sea shark (*Centroscymnus coelolepis*). Molecular Ecology, 24: 6061-6079.

Clarke, M.W., Connolly, P.L. and Bracken, J.J. 2001. Aspects of reproduction of deep-water sharks *Centroscymnus coelolepis* and *Centrophorus squamosus* from west of Ireland and Scotland. Journal of the Marine Biological Association of the United Kingdom, 81: 1019–1029.

Clarke, M.W., Connolly, P.L. and Bracken, J.J. 2002. Age estimation of the exploited deep-water shark *Centrophorus squamosus* from the continental slopes of the Rockall Trough and Porcupine Bank. Journal of Fish Biology, 60: 501–514.

Compagno, L. J. V. and Niem, V. H. 1998. Squalidae. In FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Volume 2. Cephalopods, crustaceans, holothurians and sharks, pp 1213–1232. Ed. by K.E. Carpenter and V.H. Niem. FAO, Rome.

Diez, G., Basterretxea, M., Cuende, E., Oyarzabal, I., Pedrajas, A. (2021). Abundance, biomass and CPUE of deep-water sharks in the longline survey (PALPROF) in the Bay of Biscay (ICES 8c) from 2015 to 2020. Working Document 01 presented to the Working Group on Elasmobranch Fishes. 15th – 24th, June 2021. 10 p.

Fernandes, A. C., Prista, N., Jardim, E., Silva, D. and Ferreira, A., P. 2011. Results from the 2010 Portuguese onboard sampling programme of the deepwater longline fleet with an emphasis on elasmobranch species. Working Document presented in the ICES Working Group on Elasmobranch Fishes (WGEF), Copenhagen, June 2011.

Figueiredo, I., Moura, T. 2016. The Portuguese black scabbardfish longline fishery in ICES division IXa: data needed to assess the by-catch of deep water sharks and to develop advice on possible mitigation measures to reduce the by-catches. Working Document for the ICES Working Group on Elasmobranch Fishes, Lisbon, 15-24 June 2016. 13 pp.

Figueiredo, I., Moura, T. 2019. Onboard sampling information for deep-water sharks in Portuguese mainland waters (2009-2018). Working Document presented in the ICES Working Group on Elasmobranch Fishes (WGEF), Lisbon, 18-27th June. 21 pp.

Finucci, B., Cheok, J., Cotton, C.F., Kulka, D.W., Neat, F.C., Pacoureau, N., Rigby, C.L., Tanaka, S. and Walker, T.I. 2020a. *Centroscymnus coelolepis*. The IUCN Red List of Threatened Species 2020: e.T41747A2955293. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T41747A2955293.en.

Finucci, B., Bineesh, K.K., Cheok, J., Cotton, C.F., Dharmadi, Kulka, D.W., Neat, F.C., Pacoureau, N., Rigby, C.L., Tanaka, S. and Walker, T.I. 2020b. *Centrophorus squamosus*. The IUCN Red List of Threatened Species 2020: e.T41871A68614964. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T41871A68614964.en.

Gerritsen, H. D., Minto, C., Lordan, C. 2013. How much of the seabed is impacted by mobile fishing gear? Absolute estimates from Vessel Monitoring System (VMS) point data. ICES Journal of Marine Science, 70: 523–531.

Girard M., Du Buit M. H. 1999 Reproductive biology of two deep-water sharks from the British Isles, *Centroscymnus coelolepis* and *Centrophorus squamosus* (Chondrichthyes: Squalidae). Journal of the Marine Biological Association of the UK, 79: 923–931.

Hareide, N. R. and Garnes, G. 2001. The distribution and catch rates of deep-water fish along the Mid-Atlantic Ridge from 43 to 61 N. Fisheries Research, 519: 297–310.

ICES. 2003. Report of ICES Workshop on Discard Sampling Methodology and Raising Procedures. Charlottenlund, Denmark, 2–4 September 2003.

ICES. 2011. Report of the Workshop on splitting of deep-water shark historical catch data 2011 (WKSHARK). 17th June 2011, Copenhagen, Denmark. ICES 2010/2/ACOM36; 25 pp.

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

ICES. 2013. Report of the Working Group on Elasmobranch Fishes (WGEF), 17–21 June 2013, Lisbon, Portugal. ICES CM 2013/ACOM:19, 649 pp.

ICES. 2014. Report of the Working Group on Elasmobranch Fishes (WGEF), 17–26 June 2014, Lisbon, Portugal. ICES CM 2014/ACOM:19. 887 pp.

ICES. 2016. Report of the Workshop to compile and refine catch and landings of elasmobranchs (WKSHARKS), 19–22 January 2016, Lisbon, Portugal . ICES CM 2016/ACOM:40. 69 pp.

ICES. 2018. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–28 June 2018, Lisbon, Portugal. ICES CM 2018/ACOM:16. 1306 pp.

Jansen, T., H. Degel, J. Vigneau, and E. Jardim. 2009. Definition of Standard Data-Exchange Format for Sampling, Landings, and Effort Data from Commercial Fisheries. ICES Cooperative Research Report No. 296. 43 pp.

Lagarto, N., Moura, T., Farias, I., and Figueiredo, I. 2012. Sampling information from deep-water sharks caught in the black scabbardfish fishery from mainland Portugal. Working Document to ICES WGEF; 5 pp.

Moura, T., and Figueiredo, I. 2012. Reproductive strategy and population structure of *Centroscymnus coelolepis*. Working Documento to ICES WGEF; 6 pp.

Moura, T., Figueiredo, I. and Gordo, L. 2008. Analysis of genetic structure of the Portuguese dogfish *Centroscymnus coelolepis* caught in the Northeast Atlantic using mitochondrial DNA (Control Region)-Preliminary results. Working Document to ICES WGEF.

Moura, T., Jones, E., Clarke, M.W., Cotton, C.F., Crozier, P., Daley, R.K., Diez, G., Dobby, H., Dyb, J.E., Fossen, I., Irvine, S.B., Jakobsdottir, K., López-Abellán, L.J., Lorance, P., Pascual-Alayón, P., Severino, R.B., and Figueiredo, I. 2014. Large- scale distribution of three deep-water squaloid sharks: integrating data on sex, maturity and environment. Fisheries Research, 157: 47–61.

Moura, T., Fernandes, A., Figueiredo, I., Alpoim, R., Azevedo, M. 2015. Results from the pilot study on the Portuguese trammel nets fishery targeting anglerfish in ICES Division IXa. Working Document to ICES Working Group on Elasmobranch Fishes (WGEF), Lisbon, 2015; 7 pp.

Nieto, A., Ralph, G.M., Comeros-Raynal, M.T., Kemp, J., Garcia Criado, M., *et al*. 2015. European Red List of marine fishes. Luxembourg: Publications Office of the European Union.

Prista, N., Fernandes, A.C., Maia, C., Moura, T., and Figueiredo, I. 2014 WD. Discards of elasmobranchs in the Portuguese fisheries operating in ICES Division XIa: Bottom otter trawl, deepwater set longlines, set gillnet and trammel net fisheries (2004–2013). Working Document ICES WGEF. 18 pp.

Rodríguez-Cabello, C., and Sánchez, F. 2014. Is *Centrophorus squamosus* a highly migratory deep-water shark? Deep Sea Research Part I, 92: 1–10.

Rodríguez-Cabello, C., González-Pola, C., and Sánchez, F. 2016. Migration and diving behaviour of *Centrophorus squamosus* in the NE Atlantic. Combining electronic tagging and Argo hydrography to infer deep ocean trajectories. Deep Sea Research Part I, 115: 48–62.

Rodríguez-Cabello, C., and Sánchez, F. 2017. Catch and post-release mortalities of deep-water sharks caught by bottom longlines in the Cantabrian Sea (NE Atlantic) (in press). Journal of Sea Research, 130: 248-255.

Rodríguez-Cabello, C., Pérez, M. and Grasa, I. 2020. Taxonomic research on *Deania calcea* and *Deania profundorum* (Family: Centrophoridae) in the Cantabrian Sea (Northeast Atlantic) with comments on Deania hystricosa. Regional Studies in Marine Science 37. https://doi.org/10.1016/j.rsma.2020.101321

Santos J., H. Araújo, I. Salinas and N. Pérez. 2010. Elasmobranches Results from Spanish Discard Sampling Programme. Working Document presented to WGEF 2010.

Stefanni, S., Catarino, D., Ribeiro, P.A., Freitas, M., Menezes, G.M., Neat, F. and Stankovic´, D. 2021. Molecular Systematics of the Long-Snouted Deep Water Dogfish (Centrophoridae, Deania) With Implications for Identification, Taxonomy, and Conservation. Front. Mar. Sci. 7:588192. doi: 10.3389/fmars.2020.588192

Severino, R., Afonso-Dias, I., Delgado, J., and Afonso-Dias, M. 2009. Aspects of the biology of the leaf-scale gulper shark *Centrophorus squamosus* (Bonnaterre, 1788) off Madeira archipelago. Arquipélago-Life and Marine Sciences, 26: 57–61.

Veiga, N. 2015 WD. Onboard data from the Portuguese deep-water longliners: study of the spatial overlap between deep-water sharks and the black scabbardfish. Working Document to ICES Working Group on Elasmobranch Fishes (WGEF), Lisbon, 2015; 4 pp.

Veiga, N., Moura, T., and Figueiredo, I. 2013. Spatial overlap between the leafscale gulper shark and the black scabbardfish off Portugal. Aquatic Living Resources, 26: 343–353.

Veiga, N., Moura, T. and Figueiredo, I. 2015 WD. Spatial overlap between Portuguese dogfish and the black scabbardfish off Portugal. Working Document to ICES Working Group on Elasmobranch Fishes (WGEF), Lisbon, 2015; 18 pp.

Veríssimo, A., McDowell, J.R., and Graves, J.E. 2011. Population structure of a deep-water squaloid shark, the Portuguese dogfish (*Centroscymnus coelolepis*). ICES Journal of Marine Science, 68: 555–563.

Veríssimo, A., McDowell, J.R., and Graves, J.E. 2012. Genetic population structure and connectivity in a commercially exploited and wide-ranging deepwater shark, the leafscale gulper (*Centrophorus squamosus*). Marine and Freshwater Research, 63: 505–512.

Table 3.1. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Working Group estimate of combined landings of Portuguese dogfish and leafscale gulper shark (t) by ICES area from 1998 to 2004. Landings by species not available in these years, UA, unknown area.

	4.a	5.a	5.b	6	7	8	9	10	12	14	UA	Total
1988	0	0	0	0	0	0	560	0	0	0		560
1989	12	0	0	8	0	0	507	0	0	0		527
1990	8	0	140	6	0	6	475	0	0	0		635
1991	10	0	75	1013	265	70	1075	0	1	0		2509
1992	140	1	123	2013	1171	62	1114	0	2	0		4626
1993	63	1	97	2781	1232	25	946	0	7	0		5152
1994	98	0	198	2872	2087	36	1155	0	9	0		6455
1995	78	0	272	2824	1800	45	1354	0	139	0		6512
1996	298	0	391	3639	1168	336	1189	0	147	0		7168
1997	227	0	328	4135	1637	503	1311	0	32	9		8182
1998	81	5	552	4133	1038	605	1220	0	56	15		7705
1999	55	0	469	3471	895	531	972	0	91	0		6484
2000	1	1	410	3455	892	361	1049	0	890	0		7059
2001	3	0	475	4459	2685	634	1130	0	719	0		10105
2002	10	0	215	3086	1487	669	1198	0	1416	12		8093
2003	16	0	300	3855	3926	746	1180	0	849	4		10876
2004	5	0	229	2754	3477	674	1125	0	767	0		9031

Table 3.2. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Working Group estimate of landings of Portuguese dogfish (t) by ICES area. FAO34, FAO area 34, UA, unknown area. 0 = landings <0.5 t.

	27.2	27.4	27.5	27.6	27.7	27.8	27.9	27.10	27.12	27-UA	FAO34	TOTAL
2005	0	2	149	414	392	92	541	0	8	60	256	1913
2006	0	1	138	244	214	106	537		0		25	1265
2007	0	2	133	186	14	29	143				0	507
2008		0	121	145	7	361	86				0	394
2009		0	27	47	3	4	33					114
2010		0	31	24	2	0	1				0	59
2011			1		1		1					2
2012			4				0					4
2013			2				0				0	3
2014			5								0	6
2015		0				0	0					1
2016					0	0						0
2017							3*					3
2018						0	2*					2
2019							11*					11
2020						0	9*					9

*** Landings from the deep-sea longline fisheries for black scabbardfish (Council regulation (EU) 2016/2285; Council regulation (EU) 2018/2025).**

Table 3.3. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Working Group estimate of landings of leafscale gulper shark (t) by ICES area. FAO34, FAO area 34; UA, unknown area. 0 = landings <0.5 t.

	27.2	27.4	27.5	27.6	27.7	27.8	27.9	27.10	27.12	27-UA	FAO34	TOTAL
2005	0	0	32	189	249	154	457	0	1	64	565	1712
2006		0	47	158	95	50	508		0		50	908
2007	0	0	44	28	26	2	231				0	331
2008		0	41	43	15	3	87				7	197
2009		0	50	83	4	1	26				13	177
2010		0	58	59	12	0	4				5	139
2011					3		1				3	6
2012					1		1				5	8
2013							0				4	4
2014			32		0		0				3	35
2015		1	9			0	0					10
2016							0					0
2017							7*				9*	16
2018							2*				9*	11
2019							17*				11*	28
2020		0					4*				8*	13

*** Landings from the deep-sea longline fisheries for black scabbardfish (Council regulation (EU) 2016/2285; Council regulation (EU) 2018/2025).**

Table 3.4. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Fishing hauls depth and proportion values of both species from the pilot study conducted onboard of commercial fishing vessels from the Portuguese mainland black scabbard fishery. PCYO, proportion of Portuguese dogfish; PGUQ proportion of leafscale gulper shark.

	BSF fishing grounds (depth, m)	Deeper fishing grounds (depth, m)	BSF fishing ground		Deeper fishing ground	
			P_{CYO}	P_{GUQ}	P_{CYO}	P_{GUQ}
Vessel 1	1170	1463	---	0.026	0.884	0.881
Vessel 2	1357	1461	---	0.148	0.893	0.334
Vessel 3	1180	1376	0.224	0.074	0.720	0.267
Vessel 4	1198	1382	0.122	0.112	0.820	0.734
Vessel 5	1189	1445	0.058	0.110	0.279	0.044

Table 3.5. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Spanish discard data for *Centrophorus* spp. Numbers of sampled trips and total trips are not yet available for the years 2010 onward.

Year	Celtic Sea (subareas 6–7)			Iberian Waters (divisions 8.c–9.a))		
	Sampled trips	Total trips	Raised discards (t)	Sampled trips	Total trips	Raised discards (t)
2003	9	1172	0	51	18 036	0
2004	11	1222	0	53	20 819	0
2005	10	1194	0	97	11 693	4.5
2006	13	1152	3.2	75	18 352	4.1
2007	12	1233	0	95	17 750	0
2008	11	1206	67.3	103	15 114	0
2009	15	1304	61.1	116	14 486	85.9
2010			0			29.2
2011			0			0.9
2012			173.4			0.7
2013			0			0

Table 3.6. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Total number of fishing trips, number of hauls and number of hauls with catch of Portuguese dogfish and leafscale gulper shark in French on-board observations (2005–2014).

Year	Country	Total number of:		Portuguese dogfish (positive hauls)		Leafscale gulper shark (positive hauls)	
		Trips	Hauls	Number	Proportion	Number	Proportion
2005	France	18	212	26	0.12	9	0.04
2006	France	9	106	18	0.17	1	0.01
2007	France	6	15	1	0.07	35	0.14
2008	France	18	245	12	0.05	143	0.24
2009	France	42	605	89	0.15	120	0.24
2010	France	48	504	93	0.18	71	0.16
2011	France	29	443	67	0.15	93	0.21
2012	France	32	449	35	0.08	79	0.18
2013	France	36	447	27	0.06	72	0.20
2014	France	31	365	34	0.09	9	0.04

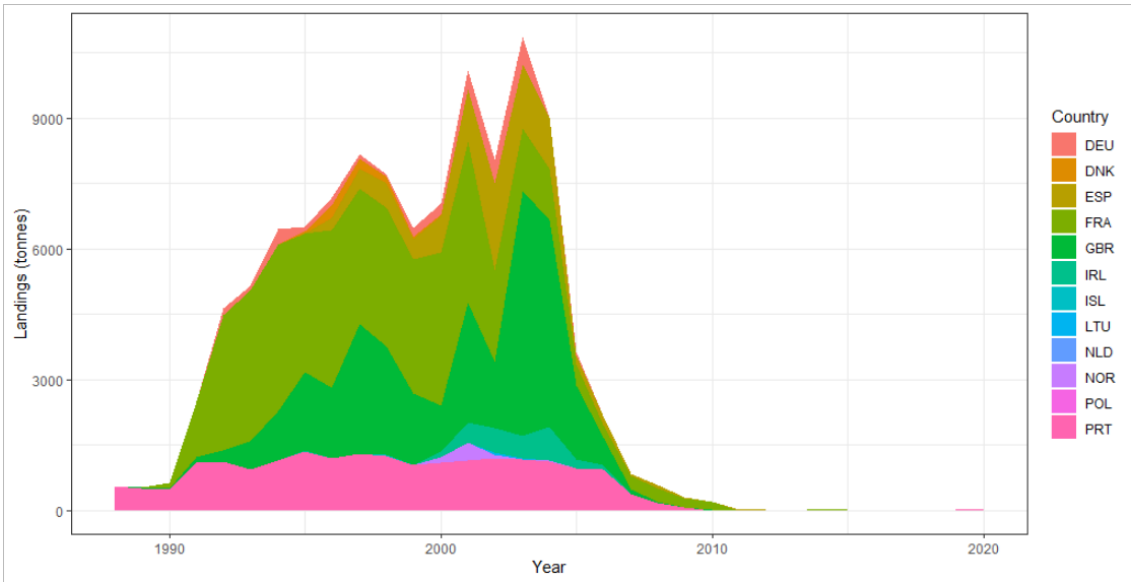

Figure 3.1. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Working Group estimates of combined landings of the two species, by country.

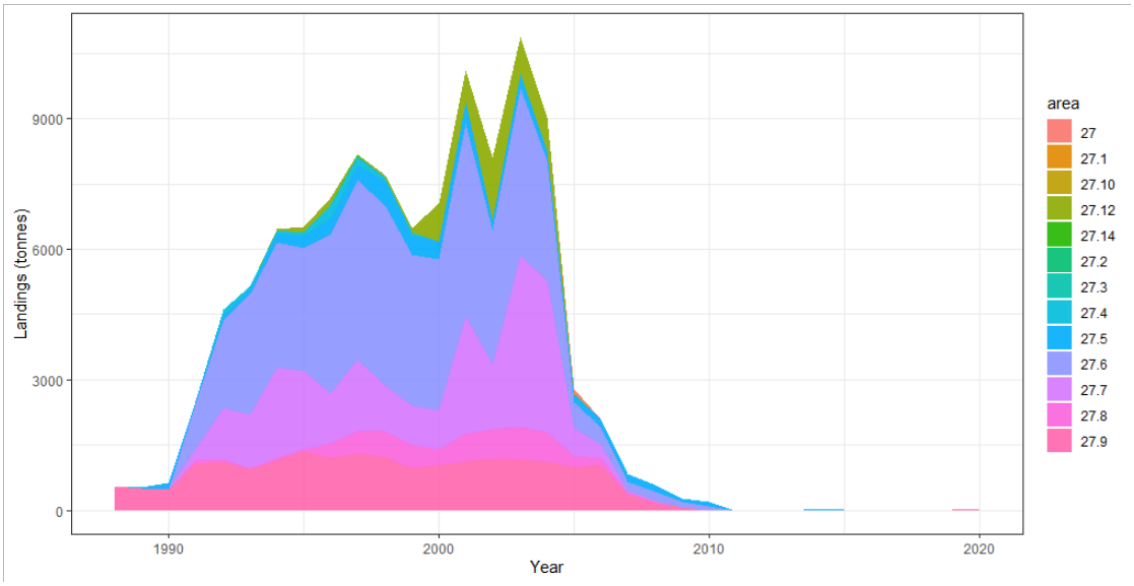

Figure 3.2. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Working Group estimates of combined landings of the two species, by ICES Subarea.

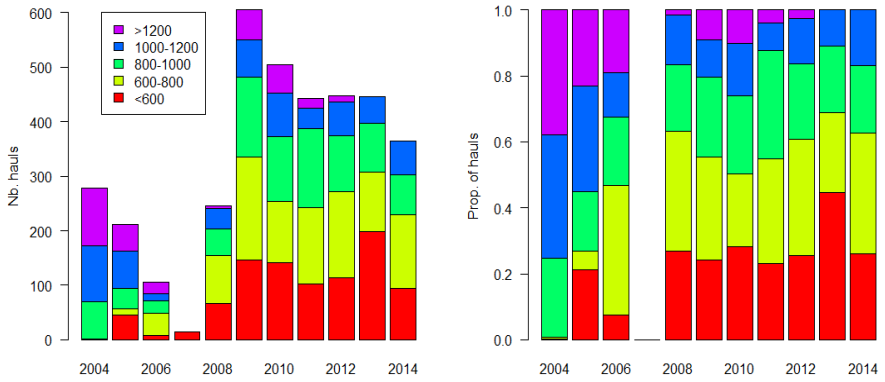

Figure 3.3. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Depth distribution of on-board observation of French deep-water fisheries 2004–2014, number of hauls per 200 m depth range (left) and proportions (right), proportions in 2007 where there was no sampling dedicated to deep-water fisheries are not given.

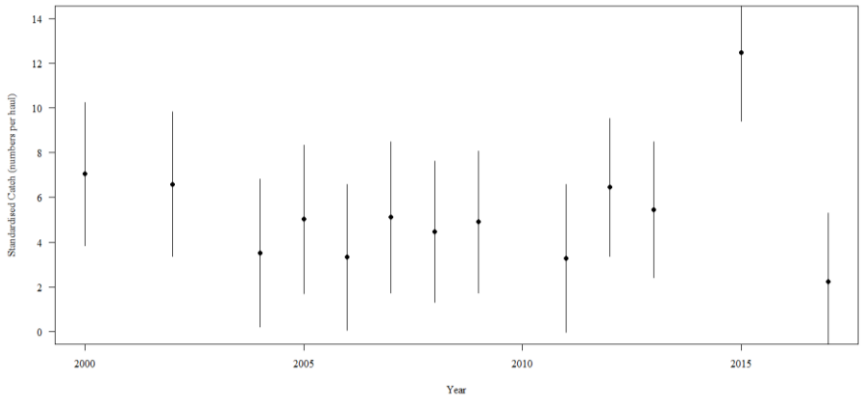

Figure 3.4. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Standardized abundance index for Portuguese dogfish in Scottish deep-water surveys 2000 to 2017.

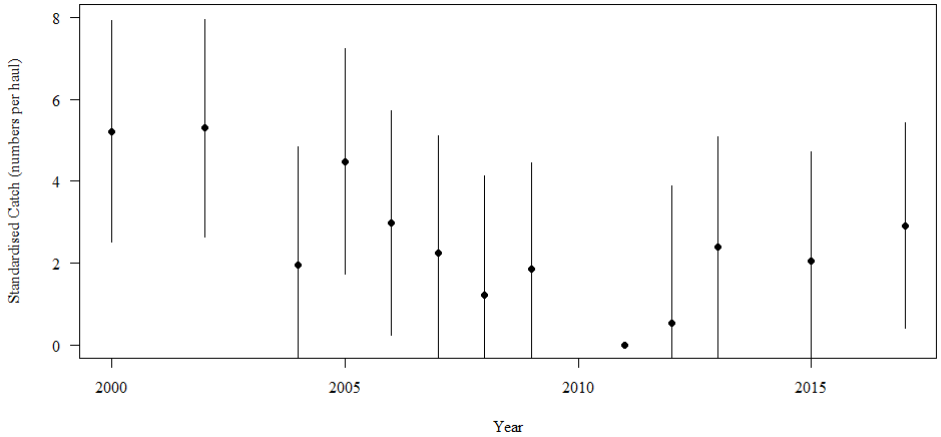

Figure 3.5. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14). Standardized abundance index for leafscale gulper shark in Scottish deep-water surveys 2000 to 2017.

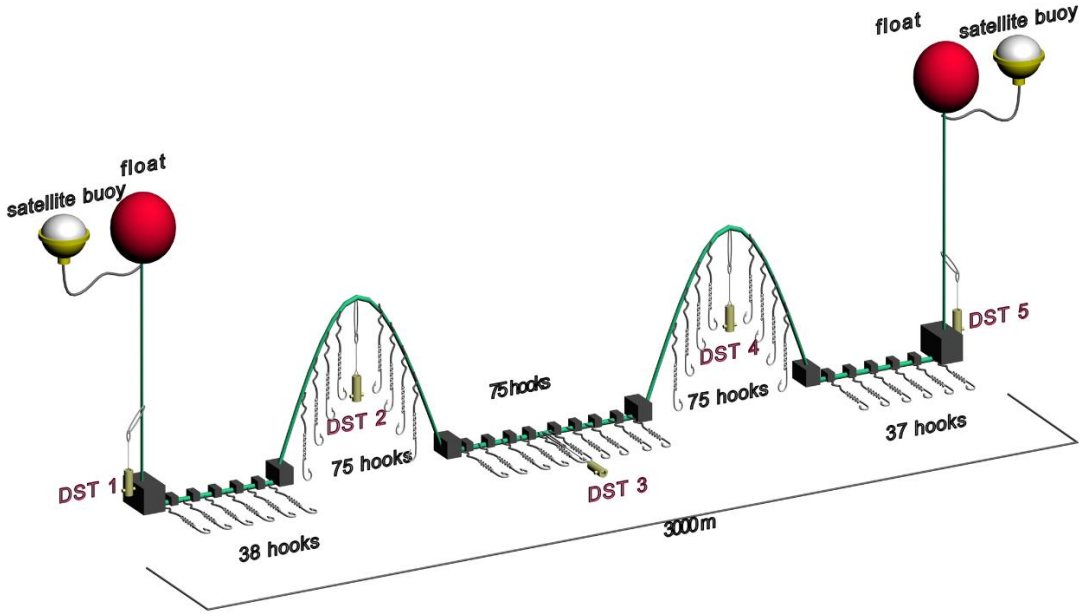

Figure 3.6. Deep-water sharks - Scheme of the final design of long-line fishing gear used in the PALPROF survey (from WD01 - Diez *et al.*, 2020).

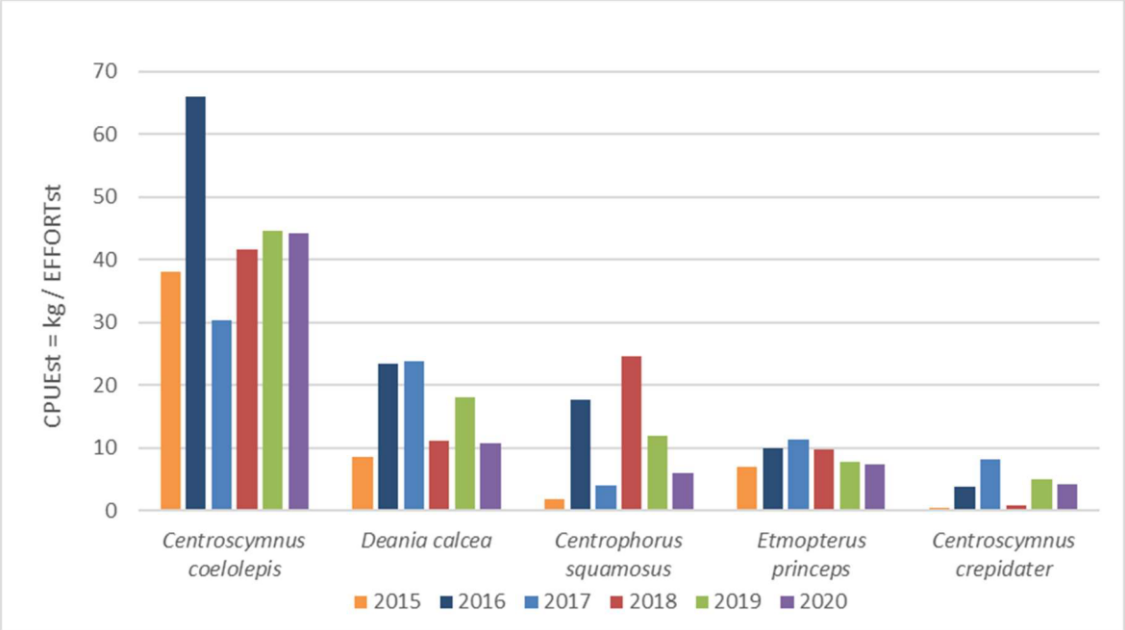

Figure 3.7 Deep-water sharks – CPUE (kg hook^{-1} min^{-1}) estimates of each of the main deep-water shark species caught by year on PALPROF survey (2015–2020; from Diez *et al.*, 2021).

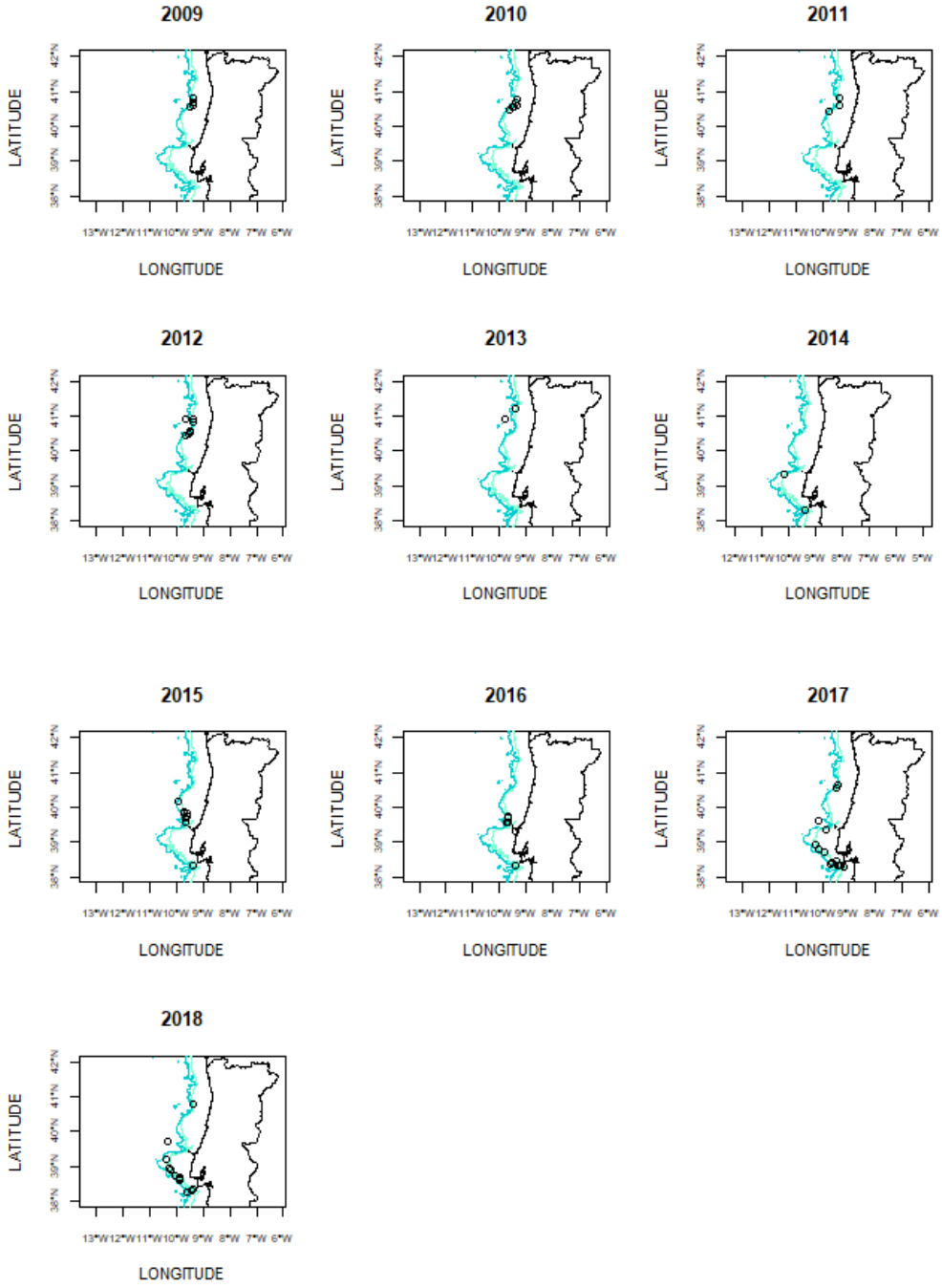

Figure 3.8. Deep-water sharks – Geographic locations of the LLS-DWS métier fishing hauls annually sampled by IPMA from 2009 to 2018.

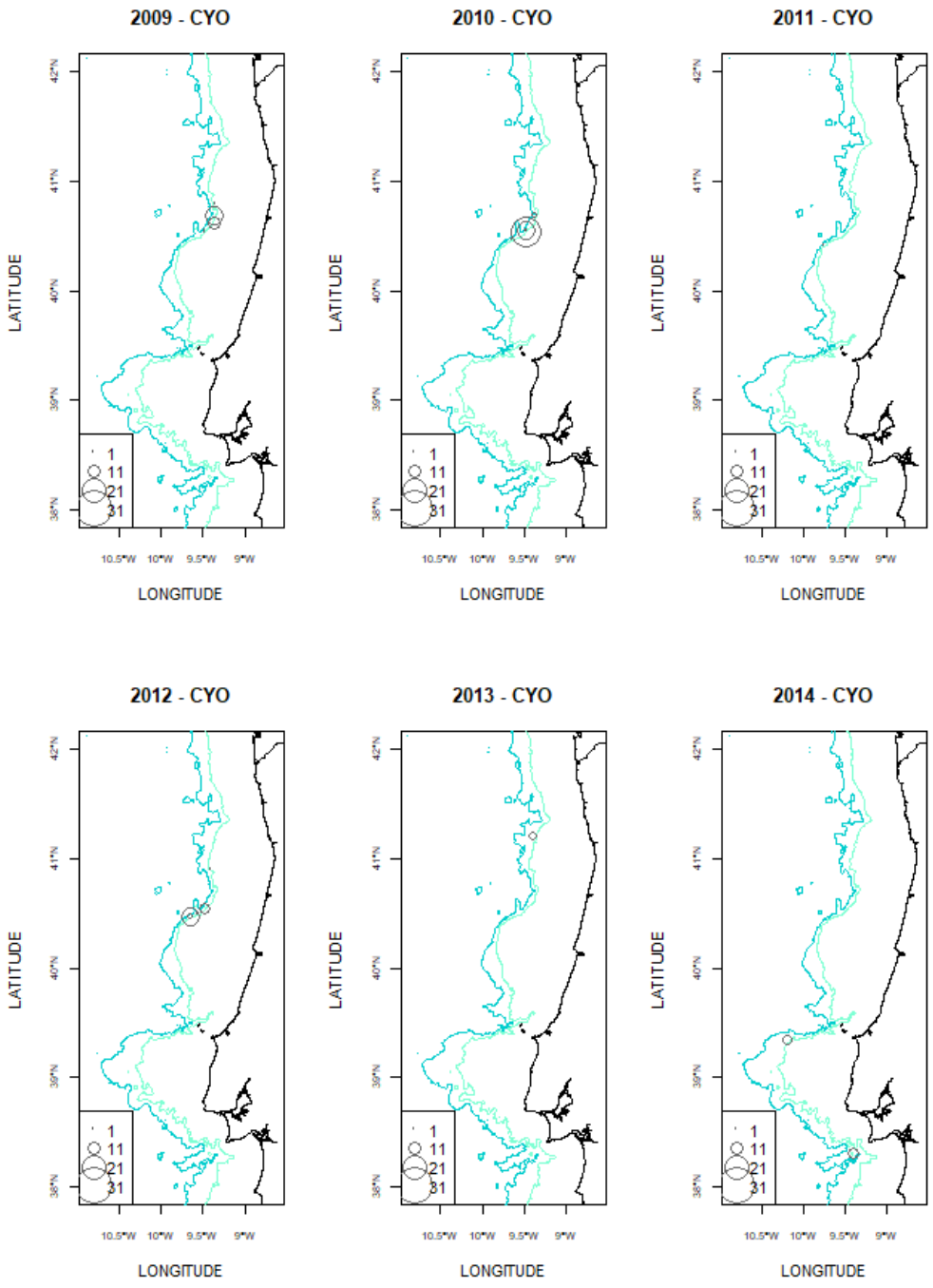

Figure 3.9. Deep-water sharks – Geographic location and number of specimens of *C. coelolepis* caught per fishing haul for the period 2009 to 2018.

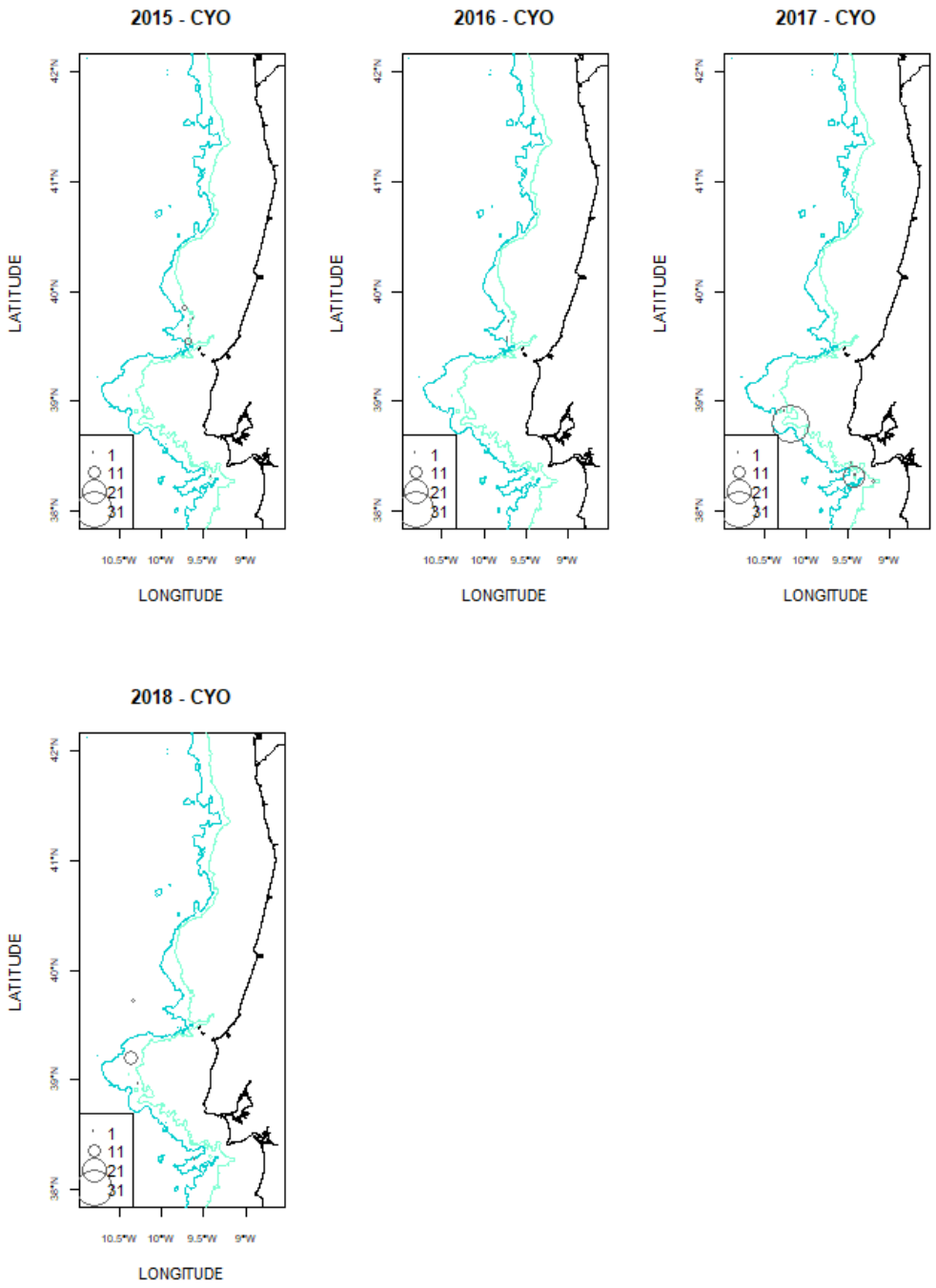

Figure 3.9 *continued* Deep-water sharks – Geographic location and number of specimens of *C. coelolepis* caught per fishing haul for the period 2009 to 2018.

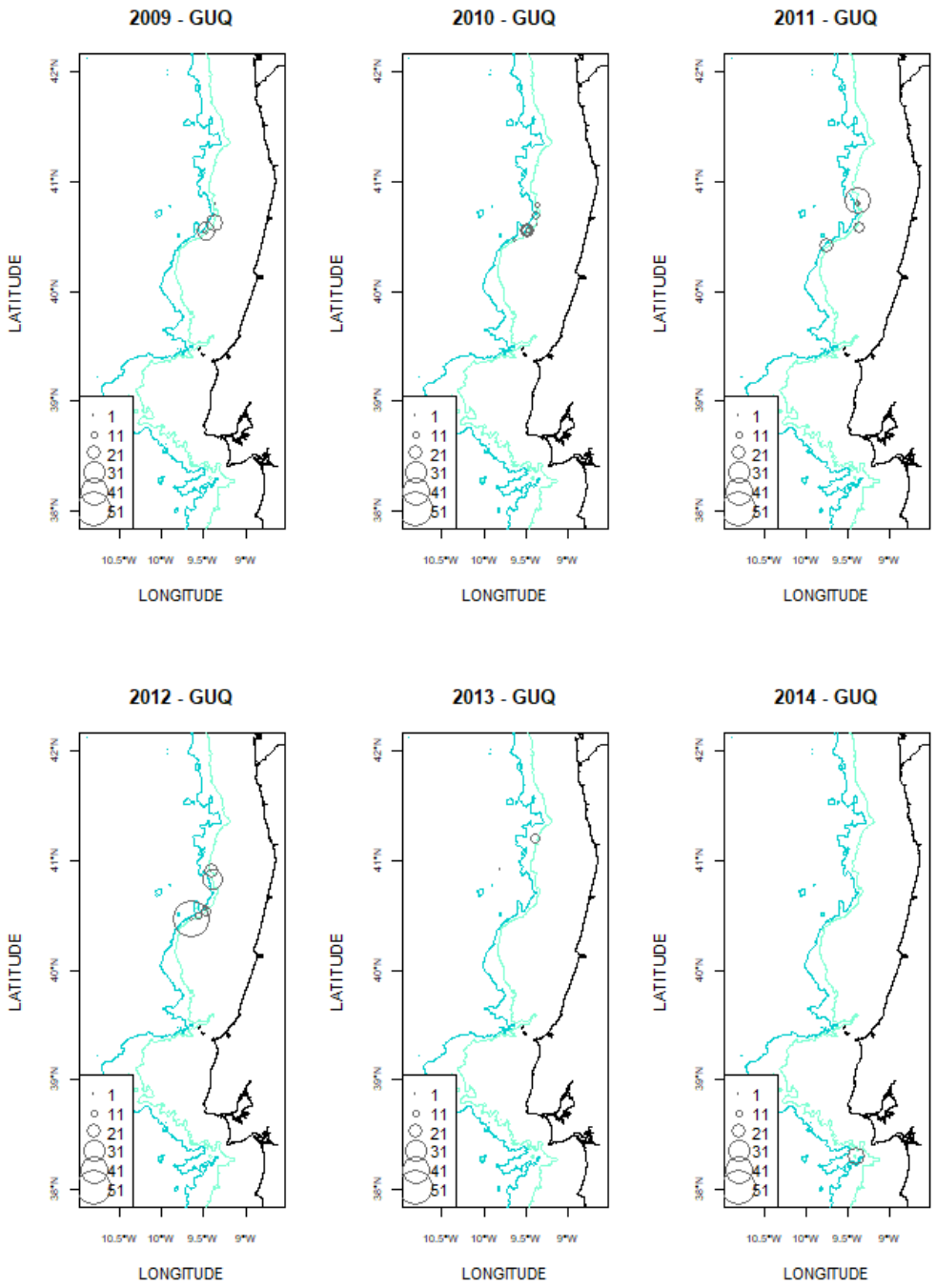

Figure 3.10. Deep-water sharks – Geographic location and number of specimens of *C. squamosus* caught per fishing haul for the period 2009 to 2018.

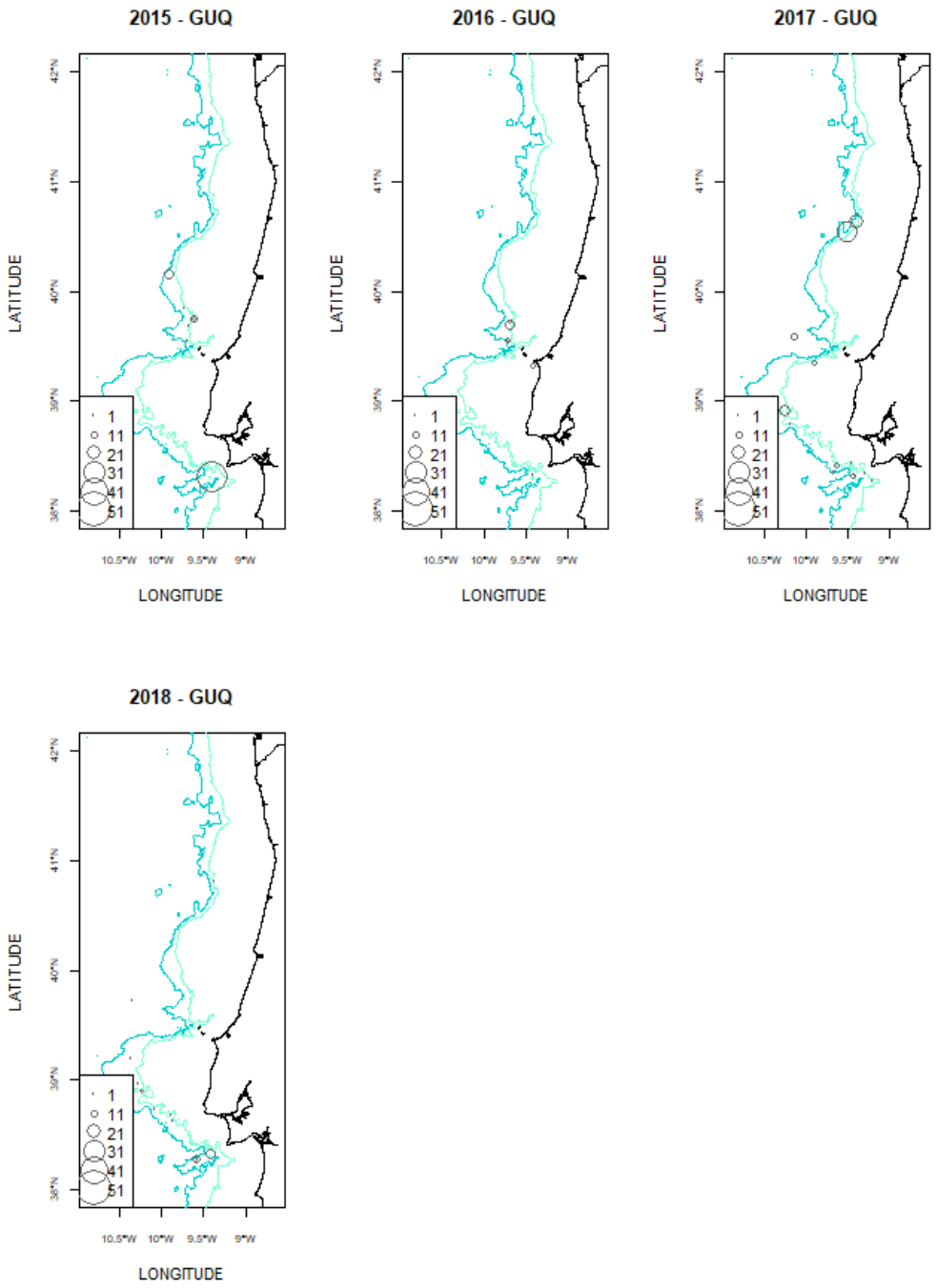

Figure 3.10. ***continued*** **Deep-water sharks – Geographic location and number of specimens of** ***C. squamosus*** **caught per fishing haul for the period 2009 to 2018.**